CLAIMS

1. A hearing prosthesis comprising:

a microphone adapted to generate an input signal in response to receiving an acoustic signal from a listening environment,

an output transducer for converting a processed output signal into an electrical or an acoustic output signal,

processing means adapted to process the input signal in accordance with a predetermined signal processing algorithm and related algorithm parameters to generate the processed output signal,

a memory area storing values of the related algorithm parameters for the predetermined signal processing algorithm,

the processing means being further adapted to:

segment the input signal into consecutive signal frames of time duration, T_{frame} , and generate respective feature vectors, $O(t)$, representing predetermined signal features of the consecutive signal frames,

compare each of the feature vectors, $O(t)$, with a feature vector set to determine, for substantially each feature vector, an associated symbol value so as to generate an observation sequence of symbol values associated with the consecutive signal frames,

process the observation sequence of symbol values with at least one discrete Hidden Markov Model, $\lambda^{source} = \{A^{source}, B^{source}, \alpha_0^{source}\}$, associated with a predetermined sound source to determine element value(s) of a classification vector indicating a probability of the predetermined sound source being active in the listening environment,

control one or several values of the related algorithm parameters in dependence of the element value(s) of the classification vector;

thereby adapting characteristics of the predetermined signal processing algorithm to the current listening environment; wherein:

A^{source} = A state transition probability matrix;

B^{source} = An observation symbol probability distribution matrix for an input observation $O(t)$ for each state of the at least one Hidden Markov Model

α_0^{source} = An initial state probability distribution vector.

2. A hearing prosthesis according to claim 1, wherein the processing means are adapted to process the observation sequence of symbol values with a plurality of discrete Hidden Markov Models associated with respective predetermined sound sources to determine the element values of the classification vector indicating a probability of each predetermined sound source.

3. A hearing prosthesis according to claim 1, wherein the feature vectors are associated with respective integer symbol values during a vector quantisation process.

4. A hearing prosthesis according to claim 1, wherein the feature vector set comprises between 8 and 256 discrete symbols.

5. A hearing prosthesis according to claim 1, wherein the feature vector set has been determined in an off-line training procedure which utilised real-life sound source recordings and stored in non-volatile memory locations of the hearing instrument.

6. A hearing prosthesis according to claim 5, wherein the real-life sound recordings have been made through an input signal path of a target hearing prosthesis or by performing a substantially similar signal processing of an input signal to simulate characteristics of the input signal path.

7. A hearing prosthesis according to claim 2, wherein the processing means further comprises a decision controller adapted to smooth inherent time scales of the plurality of discrete Hidden Markov Models by monitoring element values of the classification vector and control the one or several values of the related algorithm parameters.

8. A hearing prosthesis according to claim 7, wherein the decision controller comprises a Hidden Markov Model operating on a substantially longer time scale of the input signal than the inherent time scales of the plurality of discrete Hidden Markov Models.

9. A hearing prosthesis according to claim 7, wherein the inherent time scales of the plurality of discrete Hidden Markov Models are selected within a range of 10 – 100 ms and the substantially longer time scale of the Hidden Markov Model is selected within a range of 1-60 seconds.

10. A hearing prosthesis comprising:

a microphone adapted to generate an input signal in response to receiving an acoustic signal from a listening environment,

an output transducer for converting a processed output signal into an electrical or an acoustic output signal,

processing means adapted to process the input signal in accordance with a predetermined signal processing algorithm and related algorithm parameters to generate the processed output signal,

a memory area storing values of the related algorithm parameters for the predetermined signal processing algorithm,

the processing means being further adapted to:

segment the input signal into consecutive signal frames of time duration, T_{frame} , and generate respective feature vectors, $O(t)$, representing predetermined signal features of the consecutive signal frames,

process the feature vectors with one or a plurality of Hidden Markov Models operating on a first time scale and associated with respective predetermined sound sources to determine element values of a first classification vector indicating a probability of the predetermined sound source(s) being active in the listening environment,

process the first classification vector with a Hidden Markov Model operating at a second time scale and associated with one or more predetermined sound sources to determine element values of the classification vector,

control one or several values of the related algorithm parameters in dependence of element values of the classification vector,

thereby adapting characteristics of the predetermined signal processing algorithm to the current listening environment.

11. A hearing prosthesis according to claim 1, wherein the value of T_{frame} lies between 1 to 100 milliseconds, such as about 5 – 10 milliseconds.

12. A hearing prosthesis according to claim 10, wherein the first time scale is selected within the range 10 – 100 ms and the second time scale is selected within the range 1 – 60 seconds.

13. A hearing prosthesis according to claim 1, wherein the Hidden Markov Model or Models comprise at least one ergodic Hidden Markov Model.

14. A hearing prosthesis according to claim 1, wherein the at least one predetermined Hidden Markov Model or each of the plurality of predetermined Hidden Markov Models comprises between 2 and 10 states.

15. A hearing prosthesis comprising:

a microphone adapted to generate an input signal in response to receiving an acoustic signal from a listening environment,

an output transducer for converting a processed output signal into an electrical or an acoustic output signal,

processing means adapted to process the input signal in accordance with at least two predetermined signal processing algorithms and respective sets of algorithm parameters to generate the processed output signal,

a memory area storing values of the respective algorithm parameters for the at least two predetermined signal processing algorithms,

the processing means being further adapted to:

segment an input signal into consecutive signal frames of time duration, T_{frame} , and generate respective feature vectors, $O(t)$, representing predetermined signal features of the consecutive signal frames,

process the feature vectors with at least one Hidden Markov Model, $\lambda^{source} = \{A^{source}, b(O(t)), \alpha_0^{source}\}$, associated with a predetermined sound source to determine element values of a classification vector indicating a probability of the predetermined sound source being active in the listening environment,

control a transition between the at least two predetermined signal processing algorithms in dependence of element values of the classification vector, wherein:

A^{source} = A state transition probability matrix;

$b(O(t))$ = Probability function for an input observation $O(t)$ for each state of the at least one Hidden Markov Model;

α_0^{source} = An initial state probability distribution vector.

16. A hearing prosthesis according to claim 15, comprising a pair of omni-directional microphones generating a pair of input signals to provide the hearing prosthesis with a directional signal mode and a non-directional signal mode and wherein the processing means control the transition between the directional and non-directional signal mode.

17. A hearing prosthesis according to claim 1, 10 or 15, wherein a predetermined sound source is a natural or synthetic sound source selected from a group consisting of: {speech, telephone speech, traffic noise, multi-talker or babble noise, subway noise, transient noise, wind noise}.

18. A hearing prosthesis according to claim 17, wherein a predetermined sound source is constituted by a mixture of speech and/or traffic noise and/ or babble noise mixed together in a predetermined proportion.

19. A hearing prosthesis according to claim 1, 10 or 15, wherein a predetermined sound source is a mixture of speech and babble noise with a particular target signal to noise ratio.

20. A hearing prosthesis according to claim 1, 10 or 15, wherein the feature vectors comprise a plurality of frequency-domain parameters or a plurality of time-domain parameters or any combination thereof.

21. A hearing prosthesis according to claim 20, wherein each of the feature vectors comprises a plurality of cepstrum parameters or differential cepstrum parameters representing the predetermined signal features of the consecutive signal frames.

22. A hearing prosthesis comprising:

a microphone adapted to generate an input signal in response to receiving an acoustic signal from a listening environment,

an output transducer for converting a processed output signal into an electrical or an acoustic output signal,

processing means adapted to process the input signal in accordance with a predetermined signal processing algorithm and related algorithm parameters to generate the processed output signal,

a memory area storing values of the related algorithm parameters for the predetermined signal processing algorithm,

the processing means being further adapted to:

segment an input signal into consecutive signal frames of time duration, T_{frame} , and generate respective feature vectors, $O(t)$, representing predetermined signal features of the consecutive signal frames,

process the feature vectors with a set of Hidden Markov Models modelling respective isolated words or commands to determine element values of a classification vector indicating a probability of an isolated word or command being spoken,

thereby making the hearing prosthesis capable of recognizing a corresponding set of isolated words or commands.

23. A hearing prosthesis according to claim 22, wherein the processing means are adapted to recognize voice commands from the user to control one or several functions of the hearing aid.

24. A hearing prosthesis according to claim 22 or 23, wherein the set of Hidden Markov Models utilises left-right Hidden Markov Models.

25. A hearing prosthesis according to any of claims 22-24, wherein a training of the set of Hidden Markov Models has been performed on words or commands spoken by the user during a fitting session.

26. A hearing prosthesis according to claim 1, 10, 15 or 22, wherein the processing means comprises a software programmable processor.